

REPORT  
OF THE  
STATE BOARD OF HEALTH  
UPON THE  
IMPROVEMENT OF NEPONSET RIVER  

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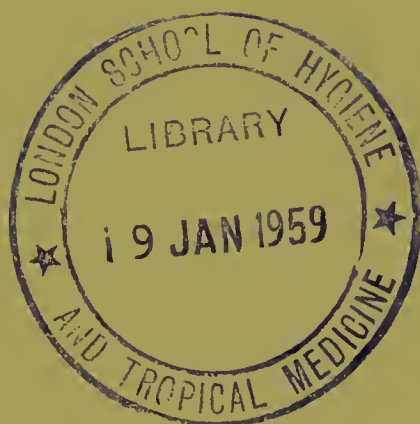


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# REPORT

OF THE

## STATE BOARD OF HEALTH

UPON THE

# SANITARY CONDITION OF THE NEPONSET MEADOWS

IN THE TOWNS OF

CANTON, SHARON, NORWOOD, DEDHAM,  
MILTON AND HYDE PARK.

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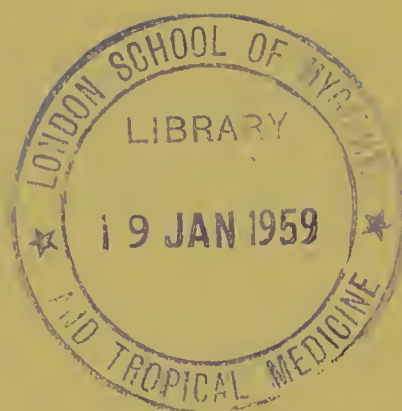
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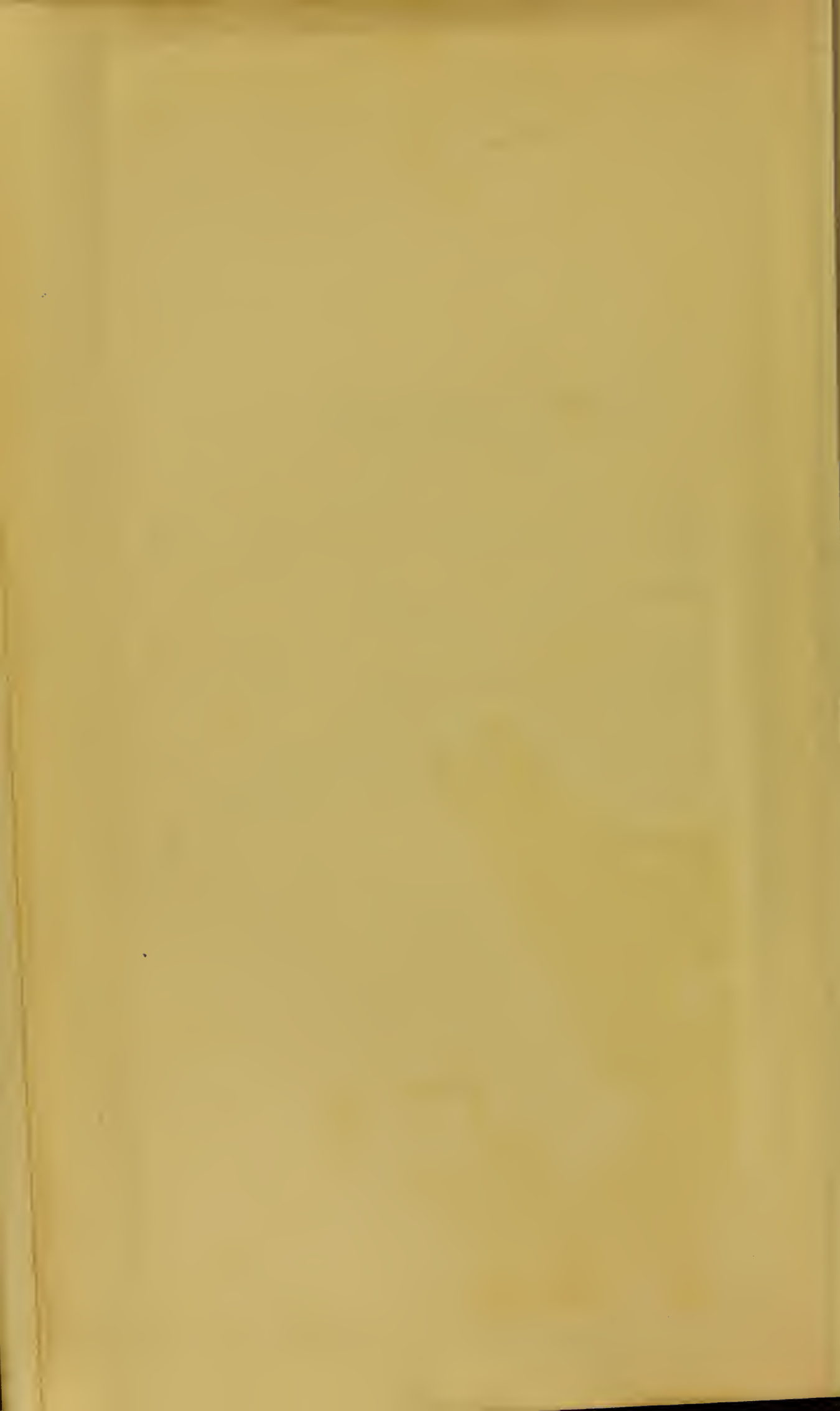
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## TABLE OF CONTENTS.

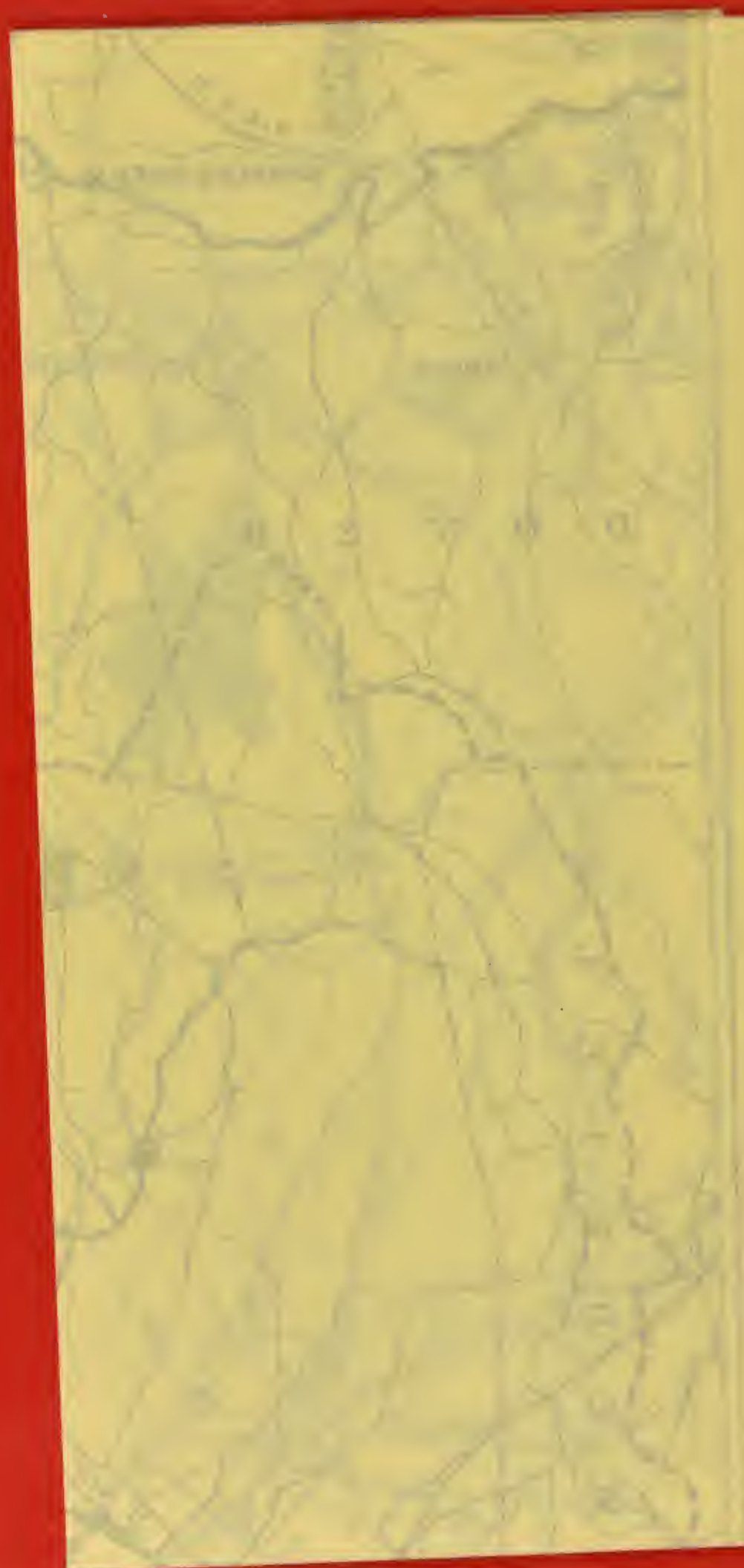
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|   | PAGE |
|---|------|
| Report of the Board, . . . . .  | v    |
| Financial Statement, . . . . .  | xi   |
| Report of the Engineer :  |      |
| Introduction, . . . . .   | 1    |
| General Conditions, . . . . .   | 1    |
| Present Condition of the River in the Great Meadows, . . . . .                              | 4    |
| Pollution of the River and its Present Sanitary Condition, . . . . .                        | 8    |
| General Character and Present Sanitary Condition of the Meadows, . . . . .                  | 14   |
| Feasibility of Improvement of the Sanitary Condition of the River and<br>Meadows, . . . . . | 17   |
| Plan for draining Meadows, . . . . .  | 20   |
| Estimated Cost, . . . . .   | 22   |
| The Effect upon the Meadows, . . . . .  | 24   |
| Report of the Chemist, . . . . .  | 28   |









REPORT  
OF THE  
STATE BOARD OF HEALTH  
UPON THE  
SANITARY CONDITION AND IMPROVEMENT OF THE  
NEPONSET MEADOWS.

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*To the Honorable the Senate and House of Representatives of the Commonwealth  
in General Court assembled.*

The State Board of Health, acting under chapter 83 of the Resolves of 1895, has investigated the sanitary condition of the meadows on the Neponset River in the towns of Canton, Sharon, Norwood, Dedham, Milton and Hyde Park, and herewith submits the results of that examination, together with recommendations for the improvement of the sanitary condition of these meadows and the removal of nuisance therefrom.

These meadows are shown upon Plan No. 1, and cover an area of 3,662 acres. Of this surface hardly more than 600 acres appear to be in a condition adapted to profitable agriculture. From the remaining territory crops of hay are obtained occasionally, or not at all. The condition of the meadows seems to have grown worse in recent years, and many of the larger owners have abandoned the attempt to secure some degree of drainage by the maintenance of open ditches, on account of the steadily diminishing returns from the crops.

At an earlier day and for a succession of years a grass known as the fowl meadow or false redtop grew on these meadows, — the first name still is used to designate the locality, — and, proving to be a valuable forage plant, gave a high value to the lands upon which it flourished. The present condition of the territory, however, is evidently not so favorable as it once was to the growth or preservation of this grass, and it is also probable that cheaper transportation



has brought into this market hay of a better quality at a price lower than that at which this marsh grass could be profitably sold. As a result of either or both of these conditions, the value of these lands has steadily fallen.

While it might be expected that the meadows should be uninhabited, as they are, it is not at first so easy to understand why the higher grounds in the vicinity should be still unoccupied by the rapidly increasing suburban population which seeks and finds acceptable building sites at distances from the business centre of Boston more considerable than any portion of the area in question. The facilities for transportation by convenient railroads are at least as good as can be found in other directions from Boston, and the towns which make up the district appear to be desirable places of residence. There has, however, for years existed a popular belief that the meadows have become a source of sickness, and this feeling seems recently to have increased. Intelligent observers report that these meadows are at times the source of disagreeable odors and the direct cause of much sickness. The examinations by this Board have shown that the upper portion of the stream was very seriously polluted, and the opinions of the physicians residing and practising in the valley, which have been from time to time collected, indicate a general belief on the part of the medical profession that the conditions affecting health here are more unfavorable than they formerly were.

The valley of the Neponset River has twice before been the subject of extended examinations by the State authorities, — first by the State Board of Health in 1875, and subsequently by the Massachusetts Drainage Commission in 1885. In addition to these examinations, a description of the Neponset River basin, with statistics relating to its pollution and analyses of its waters, may be found in the special report of the State Board of Health on the examination of water supplies, 1890, and in the twenty-second annual report of the Board. So much of the great body of facts collected by the Board as may be necessary for the purposes of this report will be found in the appended report of the engineer.

The earliest notices of these meadows give evidence that even then there were prolonged periods of flooding, and that it was found necessary to clear the bed of the stream from time to time of its obstructions, consisting of fallen trees and shrubs with the entangled rubbish. With the increasing pollution of the stream, however,



VIEW OF NEPONSET RIVER IN HYDE PARK, NOVEMBER 30, 1895. LOOKING DOWN STREAM FROM A FOOT BRIDGE.

THE HELIOTYPE PRINTING CO., BOSTON





another and more persistent interference with the current became operative. The waste matters of human life and the refuse of manufactories, when added to the waters of the stream, became efficient fertilizers for the vegetable substances that find a home there, and their increased quantity became a mechanical hindrance to the current, promoted deposits in the bed of the stream, and finally, by their decay, gave to the atmosphere odors which common experience as well as scientific knowledge declare to be injurious to health.

An accurate estimate of the amount of sickness produced by the condition of these meadows, founded upon statistical inquiry, is almost impossible, and largely for the reason that the common-sense of the people and their freedom to select more salubrious locations have prevented settlements in the immediate vicinity of these low lands. We find here, at an average distance of thirteen miles from the State House, an area of more than eleven square miles which is uninhabited. The people have not had the same objections to residence near the great salt marshes which line our coast, where the conditions of flooding and soil moisture are apparently as serious as they can be in the Neponset valley, but are not associated with a seriously polluted water or excessive growth and decay of vegetable matters.

We are of the opinion that the condition of these meadows and of the beds, shores and waters of the Neponset River is injurious to the public health. The opinions of the physicians of this district, as ascertained by an inquiry instituted by the Board, are also distinctly to the effect that the conditions which now exist here are unfavorable to health and that the unhealthful conditions are increasing in amount from year to year.

One disease has attracted considerable attention in recent years in many portions of this State, — malarial fever, — and portions of this valley have suffered from it, and severely, when the limited population is taken into account.

One farm-house was found not far removed from the meadows, but lying many feet above their level, which, well built and well cared for, had failed to offer adequate protection against an influence which, originating beyond the immediate surroundings of the house itself, was sufficiently potent to affect more than half of the ten occupants of the house.

We find that malarial diseases are uniformly prevalent in the Neponset basin, though no distinct concentration of cases has been

anywhere observed except in the case of the farm-house above cited. This is a condition of things which points distinctly to some influence which pervades the whole district, and the obvious origin of such an influence is the condition of the Fowl Meadows, with the polluted river and large areas of stagnant water. While the current theories upon the subject of malarial diseases may sufficiently explain the occurrence of these diseases in a marshy region, with stagnating water and the inevitable accompaniment of decaying vegetation, we are well aware that future scientific examination may find the really essential factor in some hitherto unsuspected condition of such territories. But it fortunately is true that malarial diseases where once prevalent have disappeared upon the removal of conditions such as those now found through the Neponset valley, and that the general healthfulness has been distinctly and immediately increased thereby.

Attention is also called to the report contained in appendix prepared by the chemist of the Board. With the co-operation of the owners of the larger manufactories on the river, a very complete examination has been made of methods for diminishing the pollution of the stream by treatment of the effluents from these establishments, and it has been found that these effluents, either by themselves or when mixed with ordinary town sewage, can be satisfactorily purified upon properly prepared sand filters. It is advisable, however, to remove by sedimentation from the factory effluent, before it reaches the filter, so much of the sludge contained therein as is possible. This sludge can be removed from the sewage by means of a settling basin of moderate dimensions, and, as it contains much more nitrogen than ordinary sewage, could probably be readily disposed of.

For the present, at least, the sparsely settled districts adjoining the meadows do not appear to be in pressing need of extended systems of sewerage; but the time will come when the same provision which is here recommended for the factory refuse should be made for the collection and purification of domestic sewage. There appear to be in the valley areas of land suited to intermittent filtration, and sufficient in quantity for the needs of the district.

Portions of the banks of the stream in the town of Hyde Park are at present in an unsanitary condition; but legislation subsequent to that authorizing this inquiry by the Board has provided a sufficient means for the relief of this state of things, through the construction of a sewer system having an outlet into the metropolitan system of sewerage.

The measures which we recommend for the remedy of the conditions injurious to health now existing in the Neponset valley are these : —

*First.* — Such additional legislation as will prevent the entrance into this stream of sewage and manufacturing wastes which have not been satisfactorily purified.

*Second.* — The permanent removal of the flashboards of the dam of the Mattapan Mills, the enlargement of the cross-section of the river at points indicated on Plan No. 3, together with a deepening and reconstruction of the channel at such places as may be found necessary for making a channel of such width and grade as will prevent the flooding of the meadows during the times of high flows in late spring and summer.

A conservative estimate of the cost of making this improvement, irrespective of land and water damages, is, in round numbers, \$125,000. The engineer also presents some figures to show the increase in the value of meadow lands reclaimed, and to this sum should also be added the enhanced value of the now neglected building sites immediately adjoining the meadows. It can thus be demonstrated, we think, that the work of improvement would be justifiable from a money stand-point alone. We have not considered it within our province to present the agricultural advantages of a drainage of this expanse of meadows. Land so well adapted, as this would be when drained, to the purposes of market gardening must always have a value near a great market far in advance of any price now paid for land in this district.

When we limit ourselves, however, to considerations of health, it scarcely seems necessary, now that a considerable portion of the State has acquired a knowledge of the depressing and disabling effects of malarial diseases, to insist upon the economical value of a freedom from the conditions that favor their prevalence. We do not hesitate, therefore, to recommend the improvement of this district, the healthfulness of which is vital to the immediate residents therein, as well as to the occupants, present and future, of the lands lying about it.

It will be remembered that, in accordance with the recommendations of the Massachusetts Drainage Commission, legislation was had now embodied in chapter 375 of the Acts of 1888. Under the provisions of this act the State Board of Health has the general oversight and care of all inland waters. The commission which suggested



the legislation above referred to used these words in their report to the Legislature of 1886 : —

Let these guardians of inland waters be charged to acquaint themselves with the actual condition of all waters within the State as respects their pollution or purity, and to inform themselves particularly as to the relation which that condition bears to the health and well-being of any part of the people of the Commonwealth. Let them do away, as far as possible, with all remediable pollution, and use every means in their power to prevent further vitiation. They shall put themselves at the disposal of manufacturers and others using rivers, streams or ponds, or in any way misusing them, to suggest the best means of minimizing the amount of dirt in their effluent, and to experiment upon methods of reducing or avoiding pollution. They shall warn the persistent violator of all reasonable regulation in the management of water of the consequences of his acts. In a word, it shall be their especial function to guard the public interest and the public health in its relation with water, whether pure or defiled, with the ultimate hope, which must never be abandoned, that sooner or later ways may be found to redeem and preserve all the waters of the State.

The suggestions contained in these sentences have governed the action of this Board during the ten years which have passed since the State Board of Health was made the official guardian of the inland waters of the Commonwealth. It is our opinion that all reasonable efforts have been exhausted in the attempt to do away with the remediable pollution of these waters, and that the time has come when the State must take more effective measures for the prevention of the pollution of the streams not now used as sources of domestic water supply, but still capable of injurious effect upon the public health.

H. P. WALCOTT.  
H. F. MILLS.  
F. W. DRAPER.  
G. C. TOBEY.  
J. W. HULL.  
C. H. PORTER.  
J. A. MEAD.







## FINANCIAL STATEMENT.

|   |            |
|---|------------|
| Appropriation, . . . . .  | \$3,000 00 |
| Expenditures : —  |            |
| Salaries of engineers, chemists and assistants, . . . . .                   | \$2,308 93 |
| Travelling expenses, . . . . .  | 269 70     |
| Cost of experimental filter tanks, including labor and materials, . . . . . | 268 12     |
| Surveying instruments and repairs, . . . . .                                | 4 00       |
| Drawing materials, . . . . .  | 34 31      |
| Maps and map mounting, . . . . .  | 3 25       |
| Photographs and photographic materials, . . . . .                           | 10 75      |
| Stationery, . . . . .   | 12 81      |
| Expressage, . . . . .   | 13 35      |
| Telephone and telegraph messages, . . . . .                                 | 1 10       |
| Rent of office, . . . . .   | 21 50      |
| Gauge readings, . . . . .   | 16 25      |
| Rent of boat, . . . . .   | 12 50      |
| Miscellaneous incidentals, . . . . .  | 17 69      |
|   | <hr/>      |
|   | \$2,994 26 |
| Balance, . . . . .  | \$5 74     |



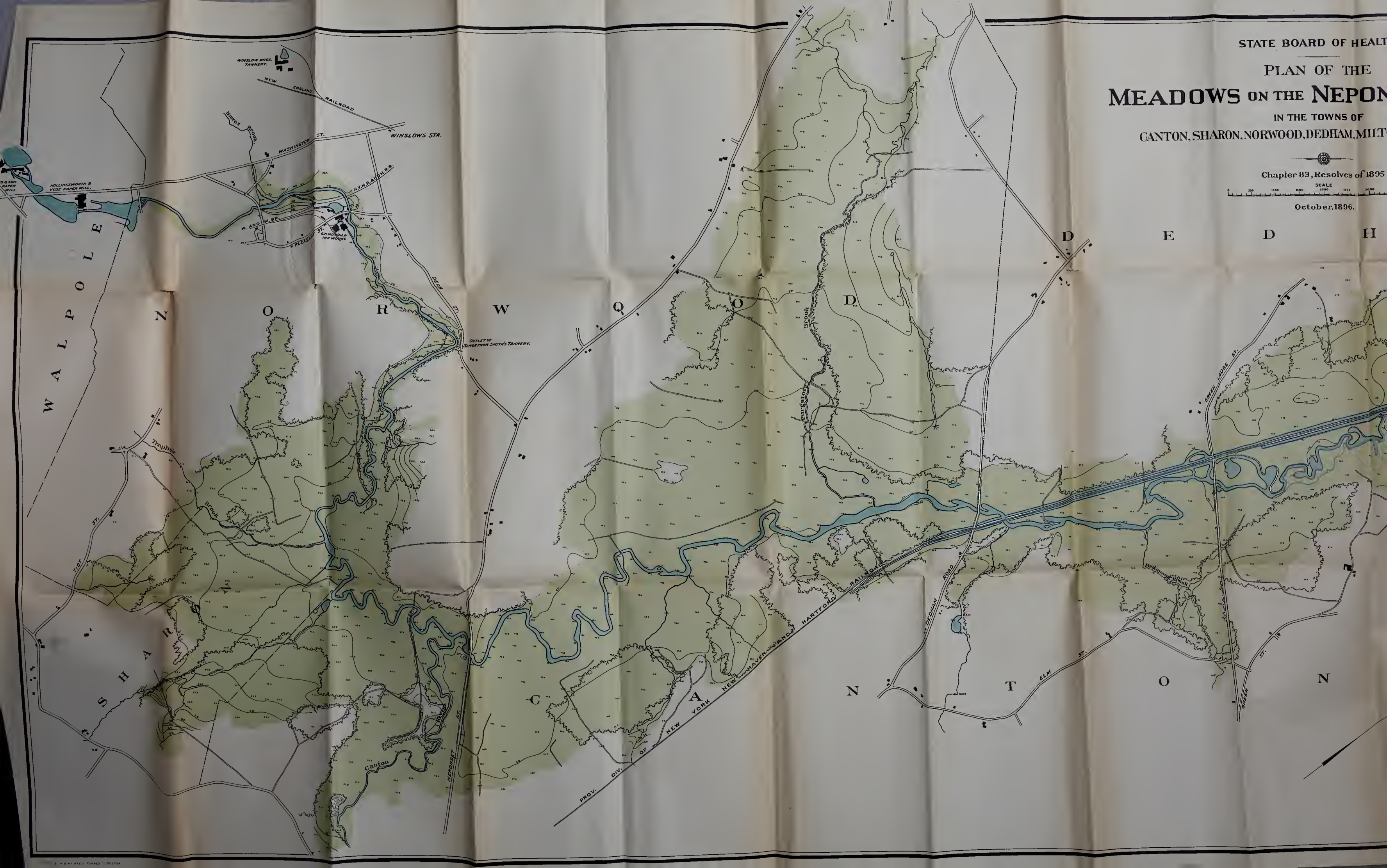


STATE BOARD OF HEALTH  
PLAN OF THE  
**MEADOWS ON THE NEPON**  
IN THE TOWNS OF  
CANTON, SHARON, NORWOOD, DEDHAM, MILTON

Chapter 83, Resolves of 1895

SCALE  
0 500 1000 1500 2000 2500 3000

October, 1896.





STATE BOARD OF HEALTH  
PLAN OF THE  
**MEADOWS ON THE NEPONSET RIVER**  
IN THE TOWNS OF  
CANTON, SHARON, NORWOOD, DEDHAM, MILTON AND HYDE PARK

Chapter 83, Resolves of 1895



October, 1896.



EXPLANATION

Meadow area shown thus .....  
Outline of wooded areas thus .....  
Contours shown thus .....  
Figures show elevations of meadow.  
All elevations are referred to Boston City Base



## ENGINEER'S REPORT.

---

OFFICE OF STATE BOARD OF HEALTH,  
STATE HOUSE, BOSTON, Oct. 1, 1896.

To H. F. MILLS, A.M., C.E., *Chairman of Committee on Water Supply and Sewerage of the State Board of Health.*

SIR:—By direction of your committee, I present herewith a report of investigations with reference to the condition of the Neponset River and meadows. The State Board of Health was directed to make these investigations by chapter 83 of the Resolves of 1895, which is as follows:—

*Resolved*, That the state board of health be directed to investigate the sanitary condition of the meadows on the Neponset river and the beds, shores and waters of said river in the towns of Canton, Sharon, Norwood, Dedham, Milton and Hyde Park, and report whether their condition is dangerous or injurious to the public health by reason of stagnant water or refuse from manufactories, or other causes. If said board shall find that the condition of the meadows or of the beds, shores or waters is dangerous or injurious to the public health, they shall recommend some plan for improving their sanitary condition and for the removal of any nuisance therefrom, and report the same to the next general court. The board may expend a sum not exceeding three thousand dollars in carrying out the provisions of this resolve.

### GENERAL CONDITIONS.

The location of the great meadows in the Neponset River basin and their situation with respect to the metropolitan district is shown upon Plan No. 1. From this plan it will be seen that the meadows occupy approximately the middle portion of the basin and that the lower portions are within ten miles of the State House.

The main river rises in the Neponset reservoir in Foxborough and flows in a generally north-easterly direction to Dorchester Bay. It has two principal tributaries: the East Branch, also known as the Canton River, which rises in Sharon and Stoughton, and, flowing through Canton, joins the main river in the great meadows near their upper end; and Mother Brook, which flows from Charles River through East Dedham and Hyde Park, and joins the main river about a mile and a half below the great meadows.

Mother Brook is legally entitled to receive one-third of the flow of Charles River, which, at the point where the brook begins, drains an area of 198.6 square miles. Mother Brook may therefore be considered as having, besides its own water-shed, an additional water-shed of 66.2 square miles.

The area of the water-shed of the Neponset River and its tributaries at various points is given in the following table:—

*Table showing Area of Water-shed of Neponset River and Tributaries at Various Points.*

|   | Square<br>Miles. |
|---|------------------|
| Neponset River above Pleasant Street (Ink Works) in Norwood, . . . . .  | 35.60            |
| Neponset River above junction with Canton River, . . . . .  | 43.88            |
| Canton River above junction with Neponset, . . . . .  | 31.17            |
| Neponset River after the entrance of Canton, . . . . .  | 75.05            |
| Neponset River above Purgatory Brook, . . . . .   | 77.34            |
| Neponset River after the entrance of Purgatory Brook, . . . . .   | 84.03            |
| Neponset River above Ponkapoag Brook, . . . . .   | 86.72            |
| Neponset River after the entrance of Ponkapoag Brook, . . . . .   | 91.07            |
| Neponset River above Mother Brook, . . . . .  | 96.28            |
| Mother Brook, . . . . .   | 1.87             |
| Mother Brook, including one-third water-shed of Charles River above<br>Mother Brook, . . . . .                                      | 68.07            |
| Neponset River after the entrance of Mother Brook, including one-third<br>water-shed of Charles River above Mother Brook, . . . . . | 164.35           |
| Neponset River at Mattapan Mills dam, including one-third water-shed<br>of Charles River above Mother Brook, . . . . .              | 165.15           |
| Neponset River at mouth, including one-third water-shed of Charles<br>River above Mother Brook, . . . . .                           | 180.34           |

The Neponset basin above the lower end of the great meadows includes the whole or the greater part of the thickly settled portions of the towns of Sharon, Stoughton, Canton, Walpole and Norwood. The population of these towns in each of the last three census years was as follows:—

| TOWNS.               | 1885.  | 1890.  | 1895.  |
|----------------------|--------|--------|--------|
| Sharon, . . . . .    | 1,328  | 1,634  | 1,717  |
| Stoughton, . . . . . | *4,025 | 4,852  | 5,272  |
| Canton, . . . . .    | 4,380  | 4,538  | 4,636  |
| Walpole, . . . . .   | 2,443  | 2,604  | 2,994  |
| Norwood, . . . . .   | 2,921  | 3,733  | 4,574  |
| Totals, . . . . .    | 15,097 | 17,361 | 19,193 |

All of these towns are provided with public water supplies, but none of them have as yet a general system of sewerage.

Below the great meadows, within the valley of the Neponset River and of Mother Brook, are included portions of Dedham, Hyde Park and Milton and the Dorchester district of the city of Boston. All of these places are increasing very rapidly in population and all are provided with public water supplies. There is no general system of sewerage in the valley of the Neponset River in these places, excepting in a portion of the Dorchester district below Mattapan; but provision for the extension of the metropolitan sewerage system in the valleys of the Neponset River and Mother Brook has been made by a recent act of the Legislature, and steps have been taken looking to the construction of systems of sewerage in Dedham, Hyde Park and Milton.

The river may be conveniently divided for the purposes of this report into three portions: an upper portion from the Neponset Reservoir at the head of the main stream to the great meadows, a middle portion where the extensive wet meadows are situated, and a lower portion within the limits of the metropolitan district, where the river flows through Hyde Park, Milton and the Dorchester district of the city of Boston.

The upper portion of the river, from the Neponset Reservoir to the great meadows, is about 10 miles in length, and has a total fall of about 220 feet. Many factories and mills are located in the vicinity of the river and of its tributaries in this region, and the river is highly polluted by manufacturing wastes. The last dam on this portion of the river is at the ink works of G. H. Morrill & Co., and below this dam the river enters the great meadows, which are continuous as far as the bridge at Milton Street, between Hyde Park and Milton, known as Paul's Bridge. (See Plan No. 3.)

\* After deducting the estimated population of the town of Avon.



The total length of the river in the great meadows from the Ink Works at Pleasant Street in Norwood to Paul's Bridge is 11.25 miles. In much of its course through the meadows the river has very little fall, and the water is purified to a considerable extent as it passes through them by dilution with the water from purer tributaries and by the deposition of suspended matters.

From Paul's Bridge to the first dam below the great meadows, at the Mattapan Paper Mill, in Hyde Park, is a distance of 2.5 miles, and in this section, excepting for a short distance below Paul's Bridge, the banks of the river are high and are occupied by factories and dwelling-houses. A large amount of pollution is turned into the river and Mother Brook in Hyde Park and in Dedham. Below the dam at the Mattapan Paper Mill the river has considerable fall to tide water, a distance of about 2.9 miles, practically all of which is made available for power by other dams.

#### PRESENT CONDITION OF THE RIVER IN THE GREAT MEADOWS.

As already stated, the total length of the stream in the great meadows from Pleasant Street to Paul's Bridge is 11.25 miles. The course of the river is extremely crooked. From Pleasant street to the bend near Dean Street the river flows in an easterly direction and its course is fairly straight. At Dean Street the course changes and its general direction is southerly to a point a short distance above Traphole Brook, where it bends to the north-east, and from this point its general course is north-easterly to within about a mile of Paul's Bridge, where there is a bend towards the east. The length of the river between prominent points in the great meadows and the distances between these points in a straight line are given in the following table : —

|   | Length of<br>River.<br>Feet. | Distance in<br>Straight Line.<br>Feet. |
|---|------------------------------|--|
| Pleasant Street to bend at Dean Street, . . . . .           | 3,740                        | 3,400                                  |
| Bend at Dean Street to bend above Traphole Brook, . . . . . | 6,440                        | 4,450                                  |
| Bend above Traphole Brook to Canton River, . . . . .        | 7,310                        | 3,750                                  |
| Canton River to Dedham Road, . . . . .                      | 17,900                       | 11,140                                 |
| Dedham Road to Green Lodge Street, . . . . .                | 7,140                        | 5,070                                  |
| Green Lodge Street to Paul's Bridge, . . . . .              | 16,910                       | 11,280                                 |
| Total feet, . . . . .                                       | 59,440                       | 39,090                                 |
| Total miles, . . . . .                                      | 11.26                        | 7.40                                   |



The width of the river in the great meadows varies considerably from point to point. Above Canton River it averages 58 feet and is about 175 feet wide at the widest place. Below Canton River it is wider, the average width from this point to Paul's Bridge being 78 feet. It is widest just above Dedham Road, where its maximum width is about 205 feet.

Connected with the river are many shallow bays with mud bottoms which are uncovered at low water. The shores are generally abrupt excepting in the bays and at the wider places. On each side of the railroad as it passes through the meadows there are wide and shallow trenches, apparently dug at the time when the railroad was constructed, which are filled with stagnant water in the summer season. In places between Green Lodge Street and Paul's Bridge the river has partially changed its course, and a portion of the flow passes through the trenches along the easterly side of the railroad. As a result of this, the river in some places has two channels with water flowing in each. The total area of the river proper in the great meadows in the summer of 1895 was about 96 acres and the total area of bays and other areas covered by water, about 52 acres.

The character of the bottom of the channel of the river has been determined by soundings at frequent intervals. It is composed of sand, gravel and mud. In the portion above Canton River and for a considerable distance below that stream the bottom appears to be covered generally with mud, upon which there is a deposit of organic matter from sewage. Lower down stream the bottom is generally composed of sand in the shallow places and of mud where the water is deep. The shallow places toward the lower end of the great meadows are generally covered with a growth of weeds. The bottoms of the numerous bays and coves generally consist of mud.

The information furnished by the surveys shows that the level of the top of the permanent dam at the Mattapan Paper Mill is about 42.3 feet above Boston city base, which is .64 of a foot below mean low water. Flashboards were found on this dam nearly 3 feet in height, the grade of the top of the flashboards being 45.2. From the dam to Paul's Bridge the river bed is in most places below the level of the permanent dam, but at Paul's Bridge there is a bar which rises a foot above this level; and from this point to Green Lodge Street the bottom, while very irregular, gradually rises to a point about three-fifths of a mile below Green Lodge Street, where there is a bar which is slightly above the level of the flashboards. From this

point to Canton River the bottom of the river is generally above grade 41 and in several places is slightly above the level of the top of the flashboards.

The fall of the stream has been determined by observations of the height of the water at numerous gauges from Pleasant Street in Norwood to the mouth of the river on two occasions: one on October 11, when the water was at the lowest level reached in 1895, the flow being about 0.3 of a cubic foot per second per square mile of watershed; and the other on October 21, at a time when the quantity flowing was about 1.7 cubic feet per second per square mile of watershed and the meadows were flooded in places. The height of the river in the lower portion of the great meadows and below has also been observed at other times. The surfaces of the water as found by the observations of October 11 and 21 are indicated by blue lines on the upper profile on Plan No. 3. The total fall of the stream from the gauge 500 feet below Pleasant Street in Norwood to the surface of the millpond above the Mattapan Paper Mill on October 11 was 9.35 feet. A little more than half this fall (4.85 feet) occurred in the first 3,000 feet between Morrill's Ink Works and the point where the river curves sharply to the south at Dean Street; and the fall between Dean Street and the Canton River, a distance of a little over 2.5 miles, was about 2.4 feet, or one-half of the remaining fall to the Mattapan Paper Mill. From Canton River to Green Lodge Street, a distance of about 4.7 miles, the flow was extremely sluggish, the fall of the stream for the entire distance being only 0.3 of a foot. From Green Lodge Street to Paul's Bridge the distance by river is 3.2 miles and the total fall 1.65 feet. The river is very crooked in this portion of its course, and the channels are greatly obstructed by bars generally covered with a growth of weeds. From Paul's Bridge to the millpond above the Mattapan Paper Mill the distance is about 2.5 miles and the fall 0.15 of a foot. The total fall from the junction of Canton River to the millpond at Mattapan Paper Mill at this time was 2.1 feet and the distance 10.4 miles.

At the time when the second set of observations was made, October 21, the rise in the water had reduced the fall between Dean Street and the mouth of the Canton River to one-half the former amount. The fall in the section of the river between Canton River and Green Lodge Street remained the same as before, 0.3 of a foot, while between Green Lodge Street and Paul's Bridge the fall was 0.25 of a foot greater than at the time of low flow, and between Paul's Bridge

and the millpond at the Mattapan Paper Mill it was 1.4 feet greater. The total fall from a gauge 500 feet below Pleasant Street to the millpond at the Mattapan Paper Mill at this time was 9.9 feet, or 0.55 of a foot greater than at the time the gaugings were made on October 11.

The fall of the stream between prominent points in the great meadows and the distance between these points are given in the following table : —

|   | Distance<br>by<br>River.<br>Feet. | OCTOBER 11, 1895. |               | OCTOBER 22, 1895. |               |
|---|-----------------------------------|-------------------|---------------|-------------------|---------------|
|   |                                   | Fall<br>in Feet.  | Slope<br>1 in | Fall<br>in Feet.  | Slope<br>1 in |
| Gauge below Morrill's Ink Works to bend at Dean Street. | 3,240                             | 4.85              | 670           | 4.95              | 650           |
| Bend at Dean Street to bend above Traphole Brook.       | 6,440                             | 1.80              | 3,580         | 0.90              | 7,160         |
| Bend above Traphole Brook to Canton River, .            | 7,310                             | 0.60              | 12,180        | 0.30              | 24,370        |
| Canton River to Dedham Road, . . . .                    | 17,900                            | 0.20              | 89,500        | 0.15              | 119,330       |
| Dedham Road to Green Lodge Street, . . .                | 7,140                             | 0.10              | 71,400        | 0.15              | 47,600        |
| Green Lodge Street to Paul's Bridge, . . .              | 16,910                            | 1.65              | 10,250        | 1.90              | 8,900         |
| Paul's Bridge to Mattapan Paper Mill dam, .             | 12,960                            | 0.15              | 86,400        | 1.55              | 8,360         |
| Totals, . . . . .                                       | 71,900                            | 9.35              | -             | 9.90              | -             |

Between Pleasant Street in Norwood and Paul's Bridge the river is crossed by three highway bridges and by a bridge of the Providence division of the New York, New Haven & Hartford Railroad. There are also in this distance two private bridges. These bridges do not appear to interfere seriously with the current of the river. There is a bar just below the Neponset Street Bridge, over which there is considerable fall when the river is low. At Paul's Bridge the river is very shallow, and there is considerable fall from the upper side to the lower side of the bridge. The next bridge below Paul's Bridge is that of the main line of the New England Railroad, where there appears to be no serious obstruction to the current except possibly at times of very high flow. Just below this bridge, however, in the yard of the New England Railroad, there is a series of eight bridges recently constructed, each supported by four rows of piles, so that there are 128 piles in the stream in a distance of 115 feet, and the lines of piles are not parallel to the direction of the current. These bridges form a very serious obstruction to the current at the present time. Below these bridges there is a high railroad embankment at the edge of the river, opposite Scott's Woolen Mill, and the width



of the river at this point is reduced to about 35 feet. Ledge is found at the bottom of the river in this vicinity. The bridges in Hyde Park also offer some obstruction to the flow of the stream, particularly the Fairmount Avenue Bridge and the railroad bridge below.

In the following table is given a list of the bridges crossing the river between the Ink Works and the Mattapan Paper Mill, with the width and height above the water at its lowest stage and the depth of the water. The bridges are arranged in order, going down stream : —

| BRIDGE.  | Total Width. | Widest Span. | Distance above Water at Lowest Stage. | Depth of Water at Lowest Stage. |
|--|--------------|--------------|---------------------------------------|---------------------------------|
|  | Feet.        | Feet.        | Feet.                                 | Feet.                           |
| Neponset Street, . . . . .                           | 50           | 23           | 5.5                                   | 3.0                             |
| Dedham Road, . . . . .                               | 70           | 18           | 5.0                                   | 7.0                             |
| Railroad Bridge, . . . . .                           | 85           | 15           | 6.0                                   | 7.0                             |
| Green Lodge Street, . . . . .                        | 60           | 28           | 5.0                                   | 10.5                            |
| Paul's Bridge, . . . . .                             | 60           | 15           | 9.0                                   | 2.0                             |
| New England Railroad, . . . . .                      | 40           | 40           | 6.0                                   | 4.0                             |
| New England Railroad freight yard bridges, . . . . . | 40           | 13           | 5.5                                   | 3.0                             |
| Bridge Street, . . . . .                             | 95           | 15           | 7.0                                   | 4.0                             |
| New England Railroad, . . . . .                      | 80           | 80           | 10.0                                  | 6.0                             |
| Fairmount Avenue, . . . . .                          | 80           | 25           | 3.5                                   | 5.0                             |
| New England Railroad, . . . . .                      | 70           | 32           | 6.0                                   | 6.5                             |

#### POLLUTION OF THE RIVER AND ITS PRESENT SANITARY CONDITION.

The condition of the water of the Neponset River has been the subject of investigation from time to time for many years. It was first examined in 1873, by the State Board of Health, when two samples of water were collected, one at Readville, presumably near Paul's Bridge, and the other below Hyde Park, but the date when the samples were collected is not given in the report.

A much more extended examination was made in 1875, when eighteen samples were collected in July and August, at various points in the river. The more important determinations from these examinations are summarized in the table on page 13. It is stated that at the time these examinations were made the river was not at the low stage that occurs in a dry summer, and there is no evidence that it was noticeably polluted at any point, unless perhaps in the vicinity of Walpole.



The next examination was made by the Massachusetts Drainage Commission, in 1885. No chemical examinations of the water of the river appear to have been made at this time, but the sources of pollution were thoroughly investigated. The odor of the river in the vicinity of the ink works is said to have been very bad. A wool-washing establishment in Walpole, where a very large amount of wool was scoured, contributed largely to the pollution of the upper portion of the stream at this time, and an action was subsequently brought in the courts by the owners of one of the paper mills at East Walpole, which resulted in the removal of the wool-washing establishment from the valley in 1890.

In 1891 an extended examination of the river was made by the State Board of Health, and samples of water from many points along its course were collected for analysis. The sources of pollution were also examined, as in 1885. The results of this examination are given in detail in the annual report of the State Board of Health for 1891. The chief sources of pollution in the portion of the river above the great meadows at that time, as at present, were the paper mills of F. W. Bird & Sons and Hollingsworth & Vose in East Walpole, near the boundary between Walpole and Norwood, and the tanneries of Winslow Bros. and the Lyman Smith's Sons' Company in Norwood.

The paper mills are located on the main stream in East Walpole and are only a short distance apart. Winslow's Tannery is located on Hawes Brook, above the point where it is crossed by the New England Railroad, and the drainage from this tannery, after flowing through settling basins, enters the brook and flows to the river, which it joins just above the Ink Works. Smith's Tannery is located in the village of Norwood, and the drainage, after flowing through settling tanks, is conducted through a pipe over a mile in length to the river, into which it discharges at the sharp bend near Dean Street.

The examinations showed that at that time the river was nearly free from pollution above the village of Walpole and was not badly polluted above the dam at Bird's Paper Mill, though it was found that considerable polluting matter entered the stream above that point. Below this mill the river was badly polluted, and the pollution was greatly increased between this point and the Ink Works by the drainage from the paper mill of Hollingsworth & Vose and the flow from Hawes Brook. From the Ink Works to the bend near

Dean Street the bed of the river was in a very foul condition, and was covered with a growth of the fungus *Beggiatoa*, which was found to extend from the paper mills down into the meadows. At the bend at Dean Street, where the river receives the discharge from Smith's sewer, there was a deposit of sewage on the bottom of the stream, and from this point to Canton River the river had a very foul odor, and the bottom toward the Canton River appeared to be covered with decomposing organic matter which had settled from the sewage as the current slackened. The Canton River, though it receives a large amount of pollution, was not in a noticeably bad sanitary condition at the point where it joins the main river, and the river was consequently improved at this point by dilution with the water of this branch. As already noted, the current is extremely sluggish for several miles below Canton River, and an opportunity is here afforded for further improvement by sedimentation, so that there was a very noticeable improvement in the character of the water opposite the pumping station of the Hyde Park Water Co. after the water had passed through the great meadows, though it was still very badly polluted. In Hyde Park the stream was polluted by refuse from many factories and by sewage from houses in the vicinity of the stream. Mother Brook, which joins the main stream at this point, also receives considerable sewage, though at the time the examination was made in 1891 the pollution of this stream was less than usual, because very little wool was being scoured by the mill at East Dedham. From Hyde Park to the mouth of the river there was very little apparent change in the quality of the water.

A prominent feature of the upper portion of the river at this time was the floating mud, which appeared on the surface of the millponds in large dark patches having a green surface, and in smaller masses further down the stream. With reference to this feature the following statement is made in the report of 1891: —

These floating masses were found in small numbers as far up stream as Stetson's millpond (above East Walpole), and were observed in much greater abundance further down stream. Their presence appeared to be due to a large deposit of putrescible matter in the bottom of the millponds, which in the warm weather became covered over and bound together with the growth of *Oscillaria* upon its surface, and was then floated by bubbles of gas resulting from the decomposition of the organic matter. In the millpond of Hollingsworth & Vose the patches of floating matter sometimes covered half an acre or more. As a rule this matter did not exceed an inch

in thickness, but near the dam of the Ink Works a large patch was noticed which measured three inches in thickness. Lumps of this matter could occasionally be seen floating down stream where the river passes through the Fowl Meadows, and undoubtedly added to the objectionable character of the scum which collected in the coves along this portion of the river.

In 1895 the condition of the river was again examined, and numerous samples were collected from the river and its tributaries at various points, between August 23 and October 12. The condition of the river was found to be much worse than in 1891. From Pleasant Street to Canton River the water was very dirty and carried a large amount of suspended matter, and floating upon its surface was an enormous number of the pieces of black mud referred to. The banks and bottom were covered with slime and refuse from manufacturing establishments above, and the odor of the stream was very offensive. Near Canton River the current slackens and some of the suspended matters are deposited, so that the bottom of the river for a long distance above and below Canton River is covered with decomposing organic matter, from which bubbles of gas rise to the surface. The floating patches of organic matter were much more numerous than in 1891, and these and probably other organic matter collecting in the coves and bays along the river through the great meadows make them extremely offensive, particularly when the water is low and the mud flats are exposed. The river was very turbid, and had a strong and very offensive odor nearly the whole length of its course through the great meadows. The growth of weeds upon the bottom of the stream was less noticeable than in 1891 in the portion of the river below Canton River. They were found in abundance, however, in the shallow places between Green Lodge Street and Paul's Bridge. The water in the bays and shallow coves was generally covered with a green scum. The odor in Hyde Park was extremely offensive from the numerous drains and privies along the banks of the stream. Further down the stream comparatively little odor was noticeable, and the condition of the river seemed to improve towards its mouth.

In the following table are given results of analyses of samples of water collected from the river in 1875, 1891 and 1895. The samples for chemical examination in 1891 and 1895 were taken at a time of very low flow in each case, and the results are comparable. The samples examined in 1875 are said to have been collected at a time when the flow was above the normal for the season.



In comparing the results of analyses made in 1895 with those of 1891, it is seen that the condition of the river above Bird's Dam in Walpole was a little worse than in 1891, as indicated by the albuminoid ammonia. Passing down the stream, the conditions were found to be, on the whole, very much worse between Bird's Dam and Canton River than in 1891, and the Canton River was also somewhat more polluted than before. The condition of the river in its course through the meadows was worse than in 1891, and there was an increase of pollution in passing through Hyde Park and a slight decrease from Hyde Park to the mouth of the river.

In addition to these special examinations of the river, a large number of chemical examinations have been made of samples collected opposite the Hyde Park Water Works, in the years 1887, 1888 and 1889, and again since 1893. The results of these examinations are also presented in the tables which follow : —



Table showing Comparison of Analyses of Water from the Neponset River in 1875, 1891 and 1895.

[Parts per 100,000.]

| LOCALITY.   | FREE AMMONIA. |       |       | TOTAL. |       |       | ALBUMINOID AMMONIA. |       |       | TOTAL SOLIDS.  |       |       | LOSS ON IGNITION. |       |        | CHLORINE. |       |       |
|---|---------------|-------|-------|--------|-------|-------|---------------------|-------|-------|----------------|-------|-------|-------------------|-------|--------|-----------|-------|-------|
|   | 1875.         | 1891. | 1895. | 1875.  | 1891. | 1895. | IN SOLUTION.        |       |       | IN SUSPENSION. |       |       | 1875.             | 1891. | 1895.  | 1875.     | 1891. | 1895. |
|   |               |       |       |        |       |       | 1875.               | 1891. | 1895. | 1875.          | 1891. | 1895. |                   |       |        |           |       |       |
| Stetson's Dam, Walpole,                             | .0046         | .0000 | .0010 | -      | .0376 | .0398 | .0216               | .0186 | .0310 | -              | .0190 | .0088 | 5.30              | -     | 8.50   | 2.62      | -     | 3.00  |
| Bird's Dam, Walpole,                                | -             | .0000 | .0012 | -      | .0338 | .0352 | -                   | .0210 | .0290 | -              | .0128 | .0062 | -                 | -     | 7.80   | -         | 2.50  | 0.78  |
| Dam at Hollingsworth & Vose's.                      | -             | .0016 | .0040 | -      | .0848 | .0660 | -                   | .0660 | .0420 | -              | .0188 | .0240 | -                 | -     | 28.80  | -         | 8.90  | 0.60  |
| One hundred feet below Hollingsworth & Vose's Mill. | -             | .0012 | .0100 | -      | .1140 | .4200 | -                   | .0540 | .0460 | -              | .0600 | .3740 | -                 | -     | 17.70  | -         | 5.80  | 1.81  |
| Bridge above Ink Works,                             | .0078         | .0200 | .1580 | -      | .1270 | .2100 | .0157               | .0670 | .1640 | -              | .0600 | .0460 | 4.96              | 26.40 | 191.40 | 2.00      | 10.40 | 4.57  |
| Below Ink Works and above Smith's sewer.            | -             | .0150 | .0800 | -      | .1466 | .1360 | -                   | .0712 | .0960 | -              | .0754 | .0400 | -                 | 26.65 | 35.50  | -         | 9.15  | 6.88  |
| One hundred feet below Smith's sewer.               | -             | .0129 | .1160 | -      | .1431 | .1800 | -                   | .0711 | .0930 | -              | .0720 | .0870 | -                 | 26.85 | 43.64  | -         | 8.20  | 5.69  |
| One hundred feet above Canton River.                | -             | .0400 | .1220 | -      | .1300 | .1560 | -                   | .0670 | .1040 | -              | .0630 | .0520 | -                 | 24.40 | 35.40  | -         | 6.40  | 8.02  |
| Canton River one hundred feet above its mouth.      | -             | .0016 | .0040 | -      | .0385 | .0360 | -                   | .0257 | .0220 | -              | .0128 | .0140 | -                 | -     | 10.30  | -         | 4.30  | 7.31  |
| One thousand feet below Canton River.               | .0082         | .0170 | .0060 | -      | .0685 | .0560 | .0176               | .0476 | .0340 | 4.66           | .0209 | .0220 | 4.66              | 14.95 | 11.20  | 2.00      | 4.85  | 0.68  |
| Paul's Bridge,                                      | .0086         | .0190 | .0654 | -      | .0510 | .0492 | .0200               | .0413 | .0382 | 5.08           | .0097 | .0110 | 5.08              | 11.40 | 14.10  | 2.12      | 3.70  | 1.35  |
| Mother Brook,                                       | .0157         | -     | .0026 | -      | -     | .0344 | .0179               | -     | .0244 | -              | -     | .0100 | 4.92              | -     | 8.40   | 2.40      | -     | 1.79  |
| Dam at Mattapan Paper Mill,                         | .0104         | -     | .0892 | -      | -     | .0466 | .0208               | -     | .0406 | -              | -     | .0060 | 5.28              | -     | 10.85  | 2.50      | -     | 0.53  |
| Milton Lower Mills,                                 | .0112         | .0274 | .0526 | -      | .0472 | .0434 | .0171               | .0329 | .0342 | 5.36           | .0143 | .0092 | 5.36              | 11.80 | -      | 2.22      | 4.00  | 2.39  |
|   |               |       |       |        |       |       |                     |       |       |                |       |       |                   |       |        | .46       | 1.18  | 1.47  |

NEPONSET MEADOWS.

Chemical Examination of Water from the Neponset River at Hyde Park.

Averages by Years.

[Parts per 100,000.]

| DATE OF COLLECTION. | Color. | RESIDUE ON<br>EVAPORA-<br>TION. |                      | AMMONIA. |             |                 |                 | Chlorine. | NITROGEN<br>AS |           | Oxygen Consumed. | Hardness. |
|---------------------|--------|---------------------------------|----------------------|----------|-------------|-----------------|-----------------|-----------|----------------|-----------|------------------|-----------|
|                     |        | Total.                          | Loss on<br>Ignition. | Free.    | Albuminoid. |                 |                 |           | Nitrates.      | Nitrites. |                  |           |
|                     |        |                                 |                      |          | Total.      | Dis-<br>solved. | Sus-<br>pended. |           |                |           |                  |           |
| 1887* . . . . .     | 1.19   | 8.35                            | 2.30                 | .0053    | .0400       | -               | -               | 0.99      | .0080          | -         | -                | -         |
| 1888 . . . . .      | 1.02   | 6.77                            | 2.27                 | .0030    | .0324       | -               | -               | 0.83      | .0095          | .0002     | -                | -         |
| 1891† . . . . .     | 1.48   | 10.34                           | 3.45                 | .0190    | .0510       | .0413           | .0097           | 1.16      | .0085          | .0003     | -                | 3.3       |
| 1892‡ . . . . .     | 0.90   | 13.30                           | 2.85                 | .0260    | .0324       | .0286           | .0038           | 2.31      | .0090          | .0012     | -                | 4.4       |
| 1893 . . . . .      | 1.16   | 7.70                            | 2.49                 | .0151    | .0320       | .0254           | .0066           | 1.19      | .0154          | .0005     | 0.9548           | 2.4       |
| 1894 . . . . .      | 1.14   | 9.68                            | 2.69                 | .0112    | .0360       | .0277           | .0083           | 1.64      | .0062          | .0002     | 1.0003           | 3.0       |
| 1895 . . . . .      | 1.04   | 8.40                            | 2.81                 | .0182    | .0365       | .0312           | .0053           | 1.18      | .0064          | .0001     | 1.0458           | 3.0       |

Averages of the Six Months from June to November, inclusive.

|                 |      |       |      |       |       |       |       |      |       |       |        |     |
|-----------------|------|-------|------|-------|-------|-------|-------|------|-------|-------|--------|-----|
| 1887 . . . . .  | 1.18 | 8.20  | 2.22 | .0053 | .0402 | -     | -     | 0.98 | .0077 | -     | -      | -   |
| 1888§ . . . . . | 1.12 | 7.77  | 2.37 | .0040 | .0371 | -     | -     | 1.08 | .0074 | .0003 | -      | -   |
| 1893 . . . . .  | 1.27 | 8.60  | 2.68 | .0233 | .0370 | .0282 | .0088 | 1.47 | .0045 | .0009 | 1.0008 | 2.6 |
| 1894 . . . . .  | 1.19 | 12.87 | 3.03 | .0196 | .0466 | .0333 | .0133 | 2.31 | .0033 | .0002 | 1.0334 | 4.1 |
| 1895 . . . . .  | 0.97 | 10.01 | 3.07 | .0341 | .0440 | .0373 | .0067 | 1.51 | .0042 | .0001 | 1.0470 | 3.7 |

The samples were collected from the river opposite the pumping station of the Hyde Park Water Company.

GENERAL CHARACTER AND PRESENT SANITARY CONDITION OF THE MEADOWS.

The extent and general features of the great meadows are shown by Plan No. 2. The results of the survey of the great meadows by the Board show that they cover a total area of 3,694 acres in several towns, including 32 acres of upland in small lots surrounded by the meadows, the area in each town being about as follows : —

\* June to December.  
† July.

‡ August and September.  
§ Average of five months, July to November.

| TOWNS.             | Area in Acres. | TOWNS.               | Area in Acres. |
|--------------------|----------------|----------------------|----------------|
| Norwood, . . . . . | 1,583          | Milton, . . . . .    | 69             |
| Canton, . . . . .  | 1,302          | Hyde Park, . . . . . | 54             |
| Dedham, . . . . .  | 443            | Total, . . . . .     | 3,694          |
| Sharon, . . . . .  | 243            |                      |                |

The elevation of the meadows has been determined at numerous points well distributed over the whole area. The results show that large areas are nearly level. About 413 acres, or about 11 per cent. of the total area, are below grade 48 ; 1,411 acres, or 38 per cent. of the area, are between grade 48 and grade 50 ; and 949 acres, or 26 per cent., are between grade 50 and grade 52. The meadows are lowest between Green Lodge Street and Paul's Bridge, where there are about 175 acres with an average elevation of about 46.7, which is less than 2 feet above the river at its lowest stage ; 50 per cent. of the meadows average only about 2 feet above the level of the water in the river at the lowest point it reached during the past dry season. In consequence of these conditions and of the character of the river, the meadows are subject to frequent overflows, not only in the winter and spring but in the drier portion of the year.

In the following table is given the elevation of the meadows in the different towns : —

| TOWNS.               | BELOW GRADE 48. |                          | Between 48 and 50 Acres. | Between 50 and 52 Acres. | Between 52 and 54 Acres. | ABOVE GRADE 54. |                          | Total. |
|----------------------|-----------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------|--------------------------|--------|
|                      | Area in Acres.  | Average Elevation. Feet. |                          |                          |                          | Area in Acres.  | Average Elevation. Feet. |        |
| Canton, . . . . .    | 111             | 47                       | 714                      | 402                      | 38                       | 37              | 58                       | 1,302  |
| Dedham, . . . . .    | 181             | 47                       | 222                      | 28                       | -                        | 12              | 60                       | 443    |
| Hyde Park, . . . . . | 54              | 47                       | -                        | -                        | -                        | -               | -                        | 54     |
| Milton, . . . . .    | 65              | 47                       | 4                        | -                        | -                        | -               | -                        | 69     |
| Norwood, . . . . .   | 2               | 47                       | 451                      | 434                      | 376                      | 320             | 57                       | 1,583  |
| Sharon, . . . . .    | -               | -                        | 20                       | 85                       | 91                       | 47              | 58                       | 243    |
| Totals, . . . . .    | 413             | -                        | 1,411                    | 949                      | 505                      | 416             | -                        | 3,694  |

Of this area, 32 acres are islands, divided among the different towns as follows : Canton, 17 acres ; Dedham, 12 acres ; Norwood, 3 acres.



In the next table is given the average elevation of the meadows between prominent points : —

| LOCALITY.                                     | BELOW<br>GRADE 48. |                                | Between 48 and 50.<br>Acres. | Between 50 and 52.<br>Acres. | Between 52 and 54.<br>Acres. | ABOVE<br>GRADE 54. |                                | Total. |
|---|--------------------|--------------------------------|------------------------------|------------------------------|------------------------------|--------------------|--------------------------------|--------|
|   | Area<br>in Acres.  | Average<br>Elevation.<br>Feet. |                              |                              |                              | Area<br>in Acres.  | Average<br>Elevation.<br>Feet. |        |
| Above Pleasant Street, . . . . .              | -                  | -                              | -                            | -                            | -                            | 32                 | -                              | 32     |
| Between Pleasant Street and Neponset Street.  | -                  | -                              | 158                          | 412                          | 244                          | 117                | -                              | 931    |
| Between Neponset Street and Dedham Road.      | 2                  | -                              | 706                          | 410                          | 261                          | 255                | -                              | 1,634  |
| Between Dedham Road and Green Lodge Street.   | 5                  | -                              | 254                          | 47                           | -                            | -                  | -                              | 306    |
| Between Green Lodge Street and Paul's Bridge. | 406                | -                              | 293                          | 80                           | -                            | 12                 | -                              | 791    |
| Totals, . . . . .                             | 413                | -                              | 1,411                        | 949                          | 505                          | 416                | -                              | 3,694  |

Of this area, 32 acres are islands, divided among the different localities as follows : between Pleasant Street and Neponset Street, 13 acres ; between Neponset Street and Dedham Road, 7 acres ; between Green Lodge Street and Paul's Bridge, 12 acres.

During the time the surveys were made in 1895 the character and condition of the meadows were noted, and from these observations it appears that areas aggregating about 1,400 acres, or about 38 per cent. of the whole area, were constantly wet, even in so dry a year as 1895. There were also indications that in ordinary seasons a considerably larger area, probably aggregating at least 50 per cent. of the whole area, is constantly wet.

Of the total area of the meadows, about 1,100 acres, or 30 per cent., were found to be covered with bushes and trees in various stages of growth and degrees of density, and nearly all of these areas are wet at all seasons of the year. Areas aggregating about 600 acres were in such a condition, on account of wetness and unevenness of surface, that little or none of the hay crop is ever harvested from them. About 1,300 acres were in a somewhat more satisfactory condition, nearly all being free from water in the summer of 1895 ; and from these areas the hay crop can apparently be secured occasionally, though in one instance the crop was gathered in 1895 for the first time in eight years, according to the statement of the owner. The remainder of the area, about 600 acres in all, appeared to be in a more satisfactory condition, and from these areas a crop of hay is usually obtained.



The condition of the meadows is said to have grown worse in the last few years, and from present indications it seems likely to continue to do so, from various causes. Some of the meadow owners state that it is found unprofitable to keep the ditches clear, with the present uncertainty of obtaining a crop from the land,—a policy which will tend to still further increase the wetness of the meadows. Areas from which the grass is not cut have already been subject to injury from the stripping of the sod in winter. When the meadows are overflowed in cold weather the long grass is sometimes frozen into the ice, and by a subsequent rise in the water the sod is often torn from large patches and deposited in other portions of the meadow. This process is locally known as “scalping,” and the areas from which the sod has been removed in many cases become filled with stagnant water in the summer season. The process is also liable to work injury to the stream by filling up the channel.

#### FEASIBILITY OF IMPROVEMENT OF THE SANITARY CONDITION OF THE RIVER AND MEADOWS.

To improve the sanitary condition of the river it will be necessary to prevent the further discharge into the stream or its tributaries of domestic and manufacturing sewage, unless it has been previously purified to a sufficient extent to prevent its being offensive to sight or smell. A general system of sewerage for the towns in the lower portion of the valley has already been provided for by chapter 406 of the Acts of 1895, and the construction of a main trunk sewer in the valleys of the Neponset River and Mother Brook was begun in 1896. By means of this system it will be possible to prevent the pollution of the river below the great meadows in the future, if some provision is made whereby the diversion of sewage from the river into the sewers is made compulsory, and the further discharge of sewage or objectionable manufacturing refuse into the main stream or its tributaries is prevented.

In the region above Hyde Park the pollution of the river at the present time is caused almost entirely by the discharge into it of manufacturing sewage, chiefly, as already noted, from paper mills and tanneries. During the summer of 1895 investigations were begun with reference to the purification of manufacturing sewage of this sort; and, while these investigations have not yet been carried far enough to indicate definitely the method of purification that would

be most satisfactory in each case, the results thus far obtained indicate that it will be feasible to purify the sewage satisfactorily at a sufficiently small cost to obviate the danger of crippling the manufacturing industries, which are at present the most important factors in the pollution of this portion of the stream. The question of the sewerage of some of the towns in this district was considered by the Massachusetts Drainage Commission in 1885, with the result that the Commission recommended plans for the disposal of the sewage of the towns of Canton, Stoughton, Sharon and Norwood separately by filtration upon land. A further study of the question in connection with the present investigation indicates that the disposal of the sewage of the towns and villages in the upper portion of the valley can be most satisfactorily accomplished by separate treatment upon land, as is done in many other towns in the State similarly situated, rather than by a general system of sewerage for the upper portion of the valley.

By purifying the sewage from the towns, as sewerage systems become necessary, and the sewage from manufacturing establishments which discharge matters which would tend to seriously pollute the streams, the portions of the river and its tributaries above the great meadows can be brought into a satisfactory sanitary condition.

The prevention of the pollution of the river and its tributaries would tend to improve the sanitary condition of the meadows, by preventing further deposit of organic matter from sewage upon the sides and bottom of the river and in the numerous shallow bays and coves; but the sanitary condition of the river would remain unsatisfactory on account of wetness and the frequent fluctuations in the level of the water in the meadows, — conditions which are regarded as unfavorable to health.

To improve the sanitary condition of the meadows it will be necessary to lower the level of the water in the river sufficiently to permit of their satisfactory drainage, and, if possible, to prevent them from being flooded during the warmer portion of the year.

The investigations have shown that this cannot be accomplished by removing the flashboards from the dam at Hyde Park, or even by removing the dam entirely, unless an extensive improvement is also made in the channel of the river. Under present conditions the height of the flashboards affects the level of the river above Green Lodge Street only to a very slight degree in the drier portion of the year; and if the dam should be removed entirely the water in the river

in a summer season like that of 1895 would probably be less than six inches lower at Green Lodge Street than it was actually found to be and about two inches lower at Neponset Street, unless the lowering of the water below should cause a wearing away of the bars in the lower part of the meadows on account of the increased velocity of the stream at times of higher water, and it is very doubtful whether any appreciable effect upon the condition of the meadows would be produced in this way.

To effect any decided improvement in the present conditions it will be necessary to deepen the river sufficiently to carry off the summer flows and keep the surface of the water in the stream sufficiently low to allow the surface of the meadows to be drained. The amount of work required in improving the channel in order to drain the meadows satisfactorily depends upon the flow to be provided for and the fall that can be obtained.

No records of the flow in the Neponset River for a long period of years are obtainable, but the conditions affecting its water-shed appear to be such that the records of flow of the Sudbury River are applicable. The Sudbury River records cover a period of twenty-one years, including years of very low and very high flow. The highest summer flow occurred in 1889, when the average flow for the highest week amounted to 3.7 cubic feet per second per square mile of watershed, the daily flow for one or two days of this week probably considerably exceeding this amount. It is probable, however, that, if the channel of the river should be sufficiently enlarged to enable it to carry 4 cubic feet per second per square mile, the meadows would be kept free of water excepting for a day or two in a week such as that in 1889 referred to.

With the exception of the records of the flow of the Sudbury River, there are no records of flows of streams in this part of the country which appear to be applicable to the conditions existing on the Neponset. Records of rainfall, however, have been kept in the eastern part of the State for long periods of years, and an examination of such records, covering a period of one hundred and thirteen years, indicates that summer months like that of August, 1889, may be expected to occur about once in from ten to fourteen years; moreover, about two or three times in a century it may happen that the flow for one of the summer months will be considerably in excess of that of August, 1889. While these estimates are not wholly reliable, they furnish, nevertheless, the most satisfactory information



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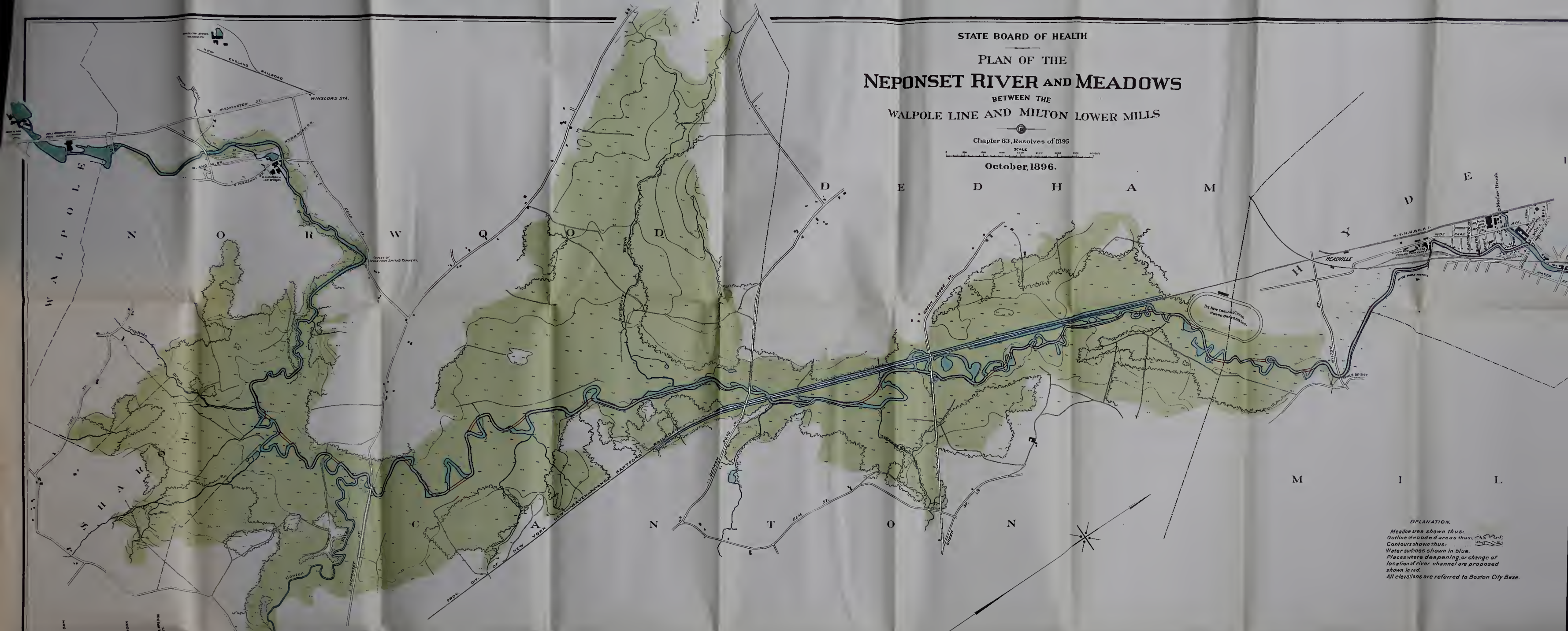


STATE BOARD OF HEALTH  
 PLAN OF THE  
**NEPONSET RIVER AND MEADOWS**  
 BETWEEN THE  
 WALPOLE LINE AND MILTON LOWER MILLS

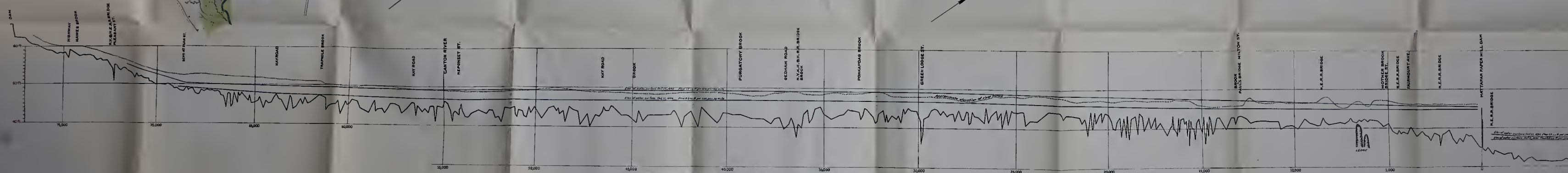
Chapter 83, Resolves of 1895

October, 1896.

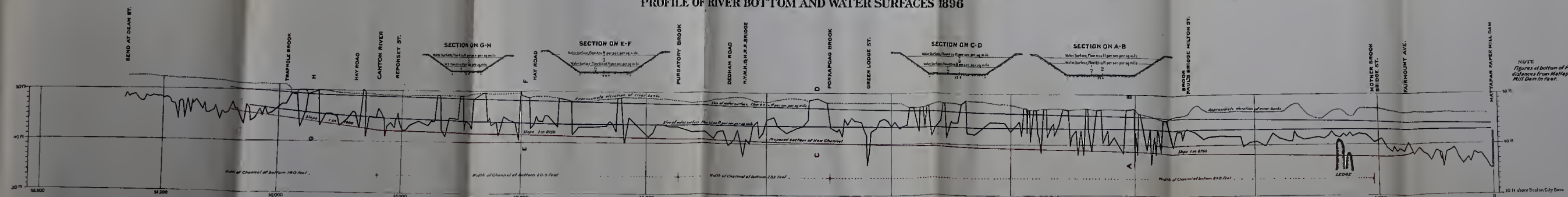
SCALE  
 1" = 1000'



EXPLANATION.  
 Meadow area shown thus:   
 Outline of wooded areas thus:   
 Contours shown thus:   
 Water surfaces shown in blue.  
 Places where deepening, or change of  
 location of river channel are proposed  
 shown in red.  
 All elevations are referred to Boston City Base.



PROFILE OF RIVER BOTTOM AND WATER SURFACES 1896



PROFILE OF PROPOSED NEW CHANNEL AND WATER SURFACES

NOTE  
 Figures at bottom of Profiles give  
 distances from Walpole Paper  
 Mill Dam in feet.






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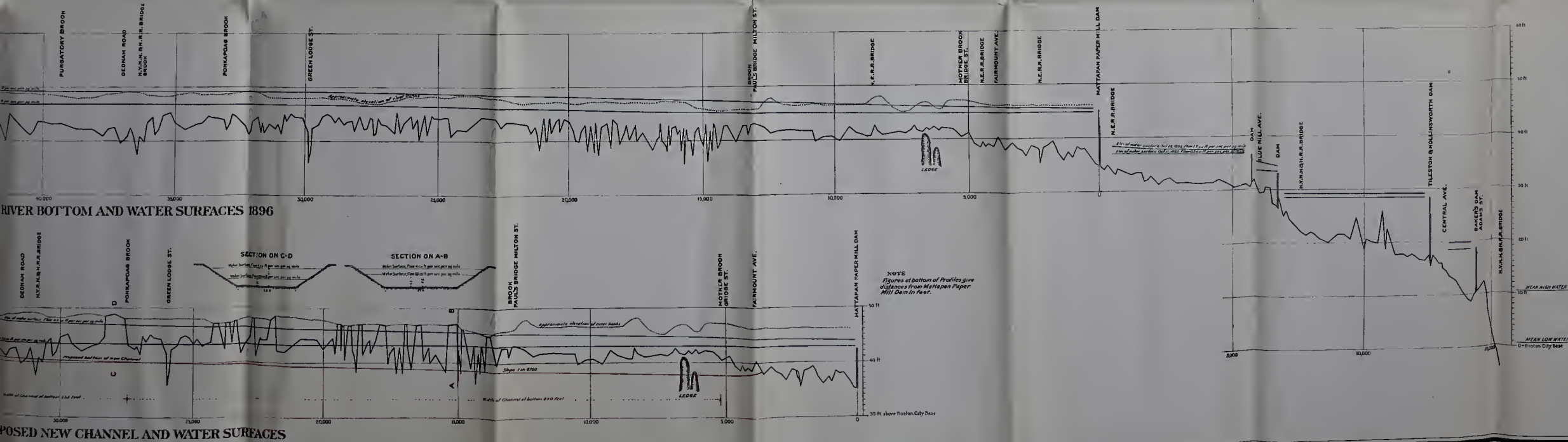
Chapter 83, Resolves of 1895

SCALE  
0 100 200 300 400 500 600 700 800 900 1000

October, 1896.



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Meadow area shown thus:   
Outline of wooded areas thus:   
Contours shown thus:   
Water surfaces shown in blue.  
Places where deepening or change of location of river channel are proposed shown in red.  
All elevations are referred to Boston City Base.









The dam, an enlargement of the cross-section of the river will be necessary at a few points indicated on the plan and profile up to a little below Bridge Street in Hyde Park. From this point the plan provides for the deepening of the channel, where necessary, to a uniform grade of 1 in 8,750, up to a point in the vicinity of Canton River, and to a grade of 1 in 1,600 from Canton River to a point 2,400 feet above Traphole Brook, and about a mile below Dean Street.

The plan shows the portions of the stream where the channel of the river would have to be deepened and the places at which it appears to be advantageous to excavate a wholly new channel.

The channel as designed would have a bottom width of 27 feet from Mother Brook to Ponkapoag Brook, a short distance above Green Lodge Street. From that point to Purgatory Brook its bottom width would be 23.5 feet, and from Purgatory Brook to Canton River 20.5 feet. Above Canton River a bottom width of 14 feet is proposed.

The grade of the bottom of the channel at Mother Brook would be about 37.6, or about 4.7 feet below the level of the top of the dam, while at Canton River the grade of the bottom of the channel would be about the same as the top of the dam.

The surface of the water of the river with 4 cubic feet per second flowing would generally be at least a foot below the level of the low portions of the meadows up to a short distance above Purgatory Brook. From this point to Traphole Brook there are several places where the surface of the river under these conditions would be only 0.3 or 0.4 of a foot below the level of the meadows. There is, however, a small area of perhaps 5 acres about 1,000 feet above Paul's Bridge which would be flooded slightly. With a flow of 0.5 of a cubic foot per second per square mile, which may be taken to represent the average flow in the middle or latter part of June, the surface of the water in the channel would be generally from 4 to 5 feet below the level of the meadows. The depth of the water in the river through the great meadows up to Canton River would be about 6.7 feet, with a flow of 4 cubic feet per second per square mile. The depth of water in the channel in summer, with a flow of 0.5 of a cubic foot per second per square mile, would be about  $4\frac{1}{2}$  feet at the lower end of the meadows, decreasing to about 3 feet at Dedham Road and to about  $2\frac{1}{2}$  feet at Canton River. The surfaces of the water in the channel with these amounts flowing have been indicated on the profile.



Through the driest months of the year the flow would average considerably less than 0.5 of a cubic foot per second per square mile.

The velocity of the water at times of high flow would be about 1.5 feet per second. This might be such as to erode the banks somewhat in places, but it does not seem likely that any serious changes in the channel would occur from this cause for many years, if at all.

Whether weeds would grow in the bottom at times of low flow in summer, and obstruct the channel, cannot be predicted with certainty. On the Concord and Sudbury rivers it was found that weeds grew from the bed of the river when the depth was less than 4 feet; but the Concord and Sudbury rivers have an extremely sluggish flow, while the flow in the Neponset would be comparatively rapid. In the Charles River weeds are also found in the shallow places where the fall is slight and the current sluggish, but in more rapid currents very little of this sort of growth is noted. Should weeds grow, the effect would be to raise the level of the water, and the effect would be felt most at times of low flow; but it is probable that at times of high flow the growth would be destroyed and largely removed by the force of the current.

Care would be necessary, in the connection of ditches and tributaries with the new channel, to excavate them to a sufficient depth and width to make the velocity at the point of entering the river as low as possible, to allow for the settlement of matters washed from the bottom of streams and ditches in heavy showers or storms, and to prevent their being carried into the river.

The material excavated in improving the channel of the river should be used in filling old channels and places where water might collect and become stagnant.

#### ESTIMATED COST.

With the money at the disposal of the Board, it has not been feasible to make the detailed survey of the river that would be required for an accurate engineering estimate of the amount and character of material to be removed. Rod soundings indicate that the material of the bottom of the river is sand, gravel and mud throughout the great meadows. The information furnished by soundings below the great meadows, between Paul's Bridge and Mother Brook, indicated the presence of ledge; and through this region a more accurate determination of the character of the river bottom has been made by means of borings, with the result that

ledge is found at only one place, just above Mother Brook, where it rises above the bottom of the proposed channel for a distance of 250 feet along the river, the material for the remainder of the distance probably being sand and gravel.

From estimates made from soundings through the centre of the river, showing the elevation of the bottom, it appears that the total amount of material that it would be necessary to remove by the plan suggested would be 199,450 cubic yards of sand, gravel and mud, and 962 cubic yards of rock.

It is probable that there will be an extra cost for enlarging the channel beneath some of the bridges below the meadows. At the first of these — Paul's Bridge — the bottom of the river will need to be deepened some 4 feet. It is said that the river has filled up considerably in this place in recent years; and if this is the case, it is possible that the foundations of the bridge are sufficiently deep to allow for the necessary deepening of the river without affecting the stability of the bridge: nevertheless, there may be an extra cost for deepening the river at this place. The channel will need to be greatly enlarged at the bridges in the freight yard of the New England Railroad, on account of the choking of the river channel by piles; and some difficulty may be encountered in providing a suitable channel here, on account of the large area of the river covered by these bridges. At Bridge Street and Fairmount Avenue the channel will also need some enlargement, which may require extra expense.

It is estimated that the cost of excavating and disposing of the sand, gravel and mud would be \$0.50 per cubic yard, and for removing the rock \$5 per cubic yard. The extra cost of enlarging the channel at the bridges below the Great Meadows is estimated at \$6,000. On this basis the total cost of constructing a channel as proposed would be as follows: —

|  |           |
|--|-----------|
| Excavating 199,450 cubic yards of sand, gravel and mud, at \$0.50, | \$99,725  |
| Excavating 962 cubic yards of rock, at \$5,                        | 4,810     |
| Enlarging the channel at Bridges below the Great Meadows,          | 6,000     |
| Total,   | \$110,535 |
| Engineering and inspection, 15 per cent.,                          | 16,580    |
| Total,   | \$127,115 |

In addition to the cost of the work, there would be the cost of land and water damages. The only water power affected is that of

the Mattapan Paper Mill. The present available fall at this mill at times of low water in summer is about 8 feet, and this fall would be reduced nearly 3 feet by the removal of flashboards. A very large amount of water is used from the river for washing purposes, and this may be the most important use of the river at these works. The proposed improvement would reduce the level at which the water from the river would be delivered to the mill, but on account of the extensive deepening of the river the reduction in the capacity of the millpond would probably be slight, if any, and the quality of the water would be much better than at present.

The question as to whether the flashboards should be removed permanently or whether they might be restored during the fall and winter seasons and removed in the spring has been carefully considered; but it seems best that the flashboards be removed permanently, in order that water be kept from covering the meadows as far as possible at all seasons of the year.

The land damages will consist chiefly of land purchased for widening and straightening the channel through the meadows, and at the present value of these lands the item of land damages would be very small.

#### THE EFFECT UPON THE MEADOWS.

The effect upon the meadows would be to prevent their being flooded, unless possibly for a day or two at a time, during the months from the first of June to the first of October, excepting years of exceptionally heavy summer rainfall, which appear to have occurred only two or three times in a century, when the meadows might be flooded for a period of several days; moreover, in nine years out of ten the meadows would probably be free from water after the 10th of May, and in four years out of five they would be free from water during the whole month of May. They would also probably be free from water during the month of October, excepting one year in from sixteen to twenty years.

It is not thought that the amount of lowering of the water would be sufficient to cause a serious lowering of the surface of the meadows, though some lowering might take place. The meadows could be drained, and their sanitary condition greatly improved and their value for agricultural purposes would be increased. In order to learn, if possible, how much the increase in their valuation might amount to, such information as could be obtained from the assessors of the



various towns has been collected. At Norwood, Dedham and Hyde Park it was possible to obtain a practically complete list of all the separate lots in the meadows within these towns and the assessed value of each lot, and the area assessed corresponds very nearly with the area found by survey. In Canton, Sharon and Milton no such detailed information as to the different lots and the assessed value of each was obtainable; but in the first two towns an approximate estimate of the value has been obtained from the assessors, who have gone over the plans and indicated the valuation of portions of the meadows, showing the limits of the areas having approximately the same valuation. By subsequently measuring these areas, an estimate of the valuation of the meadow lands in these towns has been obtained. The amount of meadow in Milton is small, and the assessors state that it is all valued at practically the same rate. In the following table is given the area of the meadow land in each town, as obtained by survey, and the area obtained from the assessors' records and statements in cases where such information was obtainable:—

| TOWNS.           | Area<br>measured<br>on Map. | Assessors'<br>Estimate. | TOWNS.         | Area<br>measured<br>on Map. | Assessors'<br>Estimate. |
|------------------|-----------------------------|-------------------------|----------------|-----------------------------|-------------------------|
|                  | Acres.                      | Acres.                  |                | Acres.                      | Acres.                  |
| Canton, . . .    | 1,302                       | 1,302*                  | Norwood, . . . | 1,583                       | 1,543                   |
| Dedham, . . .    | 443                         | 437                     | Sharon, . . .  | 243                         | 243*                    |
| Hyde Park, . . . | 54                          | 61                      |                |                             |                         |
| Milton, . . .    | 69                          | 69*                     | Totals, . . .  | 3,694                       | 3,655                   |

Classifying the areas according to the valuation per acre, the number of acres in each town having approximately a given valuation is as follows:—

| TOWNS.           | Number of Acres<br>valued below<br>\$10.00 per Acre. | Number of Acres<br>valued from<br>\$10.00 to \$19.99<br>per Acre. | Number of Acres<br>valued from<br>\$20.00 to \$29.99<br>per Acre. | Number of Acres<br>valued from<br>\$30.00 to \$39.99<br>per Acre. | Number of Acres<br>valued from<br>\$40.00 to \$49.99<br>per Acre. | Number of Acres<br>valued from<br>\$50.00 to \$99.99<br>per Acre. | Number of Acres<br>valued above<br>\$100.00 per Acre. |
|------------------|--|---|---|---|---|---|---|
| Canton, . . .    | —  | 211   | 953   | 57  | —   | 51  | —   |
| Dedham, . . .    | —  | 222   | 93  | —   | 38  | 64  | 20  |
| Hyde Park, . . . | —  | —   | —   | —   | —   | 19  | 42  |
| Milton, . . .    | —  | —   | —   | —   | —   | 69  | —   |
| Norwood, . . .   | 85   | 813   | 244   | 206   | 129   | 55  | 11  |
| Sharon, . . .    | 88   | —   | 144   | —   | —   | 11  | —   |
| Totals, . . .    | 173  | 1,276   | 1,434   | 263   | 167   | 269   | 73  |

\* No figures could be obtained from the assessors, and figures from map are given instead.

Summary.

| VALUATION.                              | Number<br>of<br>Acres. | Total<br>Valuation. | Average<br>Valuation<br>per<br>Acre. |
|---|------------------------|---------------------|--------------------------------------|
| Valuation below \$10.00 per acre, . . . | 173                    | \$1,225             | \$7.08                               |
| \$10 to 19.99 per acre, . . .           | 1,276                  | 15,007              | 11.76                                |
| 20 to 29.99 per acre, . . .             | 1,434                  | 32,608              | 22.74                                |
| 30 to 39.99 per acre, . . .             | 263                    | 8,285               | 31.50                                |
| 40 to 49.99 per acre, . . .             | 167                    | 7,195               | 43.08                                |
| 50 to 99.99 per acre, . . .             | 269                    | 16,524              | 61.43                                |
| 100 and above per acre, . . .           | 73                     | 10,130              | 138.77                               |
|   | 3,655                  | \$90,974            | \$29.89                              |

Very little information has been obtained as to what the probable value of the meadow lands would be after providing for their drainage as proposed. Assessors in the towns where most of the meadow lands are situated appear to be of the opinion that if the meadows could be restored to their original condition they would be valued for purposes of taxation at about \$50 per acre. This may indicate that their value would be equivalent to this amount on account of the hay crop. It is said that the meadow lands were for many years thought to be worth \$100 per acre, and there are those who think that if the meadows were properly drained they would again be worth this amount. .

The total area of the meadows, as already stated, as found by the assessors' estimates, is 3,655 acres, of which 3,313 acres, or a little over 90 per cent., are valued at less than \$50 per acre. If by draining the meadows the valuation of these portions would be raised to \$50 per acre, the increase in the taxable valuation of the meadows would be as shown in the following table : —

| VALUE PER ACRE.                      | Number<br>of<br>Acres. | Total<br>Present<br>Valuation. | Total Valuation after<br>Draining. |
|--------------------------------------|------------------------|--------------------------------|------------------------------------|
| Below \$50, . . . . .                | 3,313                  | \$64,320                       | \$165,650                          |
| Above \$50, . . . . .                | 342                    | 26,654                         | 26,654                             |
| Totals, . . . . .                    | 3,655                  | \$90,974                       | \$192,304                          |
| Net increase in valuation, . . . . . |                        |                                | \$101,330                          |

The gain in the valuation of the meadows which would be produced by draining them probably does not represent wholly the economic value of the improvement. Should the river and meadows continue in their present condition, and become not only a source of annoyance but a menace to the health of those living near them, as they seem destined to do if the present conditions are allowed to continue, the value of real estate in the vicinity of the meadows is likely to be unfavorably affected thereby. It is possible, moreover, that portions of the meadows could be utilized for market gardening after draining, and, if this should be the case, the value of such portions would be much greater than if they were available for hay and pasturage alone.

Respectfully submitted,

X. H. GOODNOUGH,

*Chief Engineer.*



REPORT OF THE CHEMIST.

LAWRENCE, MASS., Nov. 23, 1896.

Mr. HIRAM F. MILLS, *Chairman of Committee on Water Supply and Sewerage of the State Board of Health.*

DEAR SIR: — Inspection and chemical examinations of the water of the Neponset River at different places along its course have made clear that, at the present time, the main pollutions of the river above the Neponset meadows are the waste liquors from the paper mills of F. W. Bird & Son and Hollingsworth & Vose in East Walpole, and the tanneries of Winslow Brothers and Lyman Smith's Sons in Norwood.

The first in order of these sources of pollution, beginning up the river, is the mill of F. W. Bird & Son. The water in the pond directly above Bird's mill has an average analysis during the summer about as follows: —

[Parts per 100,000.]

| Residue on Evaporation. | Loss on Ignition. | AMMONIA. |             | Chlorine. | Oxygen Consumed. | Hardness. |
|-------------------------|-------------------|----------|-------------|-----------|------------------|-----------|
|                         |                   | Free.    | Albuminoid. |           |                  |           |
| 7.80                    | 2.50              | .0010    | .0350       | .60       | .98              | 1.90      |

The water in the pond below Bird's mill and above the mill of Hollingsworth & Vose has an average analysis about as follows: —

[Parts per 100,000.]

| Residue on Evaporation. | Loss on Ignition. | AMMONIA. |             | Chlorine. | Oxygen Consumed. | Hardness. |
|-------------------------|-------------------|----------|-------------|-----------|------------------|-----------|
|                         |                   | Free.    | Albuminoid. |           |                  |           |
| 32.00                   | 10.30             | .0100    | .0780       | 2.20      | 2.70             | 11.50     |

These analyses were made in each case from samples of the water collected within a foot or two of the surface of the pond.

During the year ending July 1, 1896, this mill of F. W. Bird & Son worked up about 5,100 tons of stock. This stock consists largely of old paper, but includes also a considerable amount of old rope and bagging and a small amount of old oil-cloth. In the process of making this stock into paper for the market about 1,000 tons of chemicals and dyestuffs are used yearly, consisting of alum, quick-lime, chloride of lime or bleach, soda ash, copperas, clay, venetian red, yellow ochre, lamp-black, soluble blue, logwood extract, starch, aniline dyes, bichromate of lead, etc.

All the dirt washed from the stock, together with a considerable amount of fibre and all the waste liquors, passes to the mill pond of Hollingsworth & Vose. This mill is about 1,400 feet below Bird's mill, and turns out about 12 tons of paper daily. A large amount of chloride of lime, quick-lime, alum, etc., is used at this mill. The stock is first machine dusted, and the dirt removed in this way is given to farmers. All the remaining dirt and waste liquors are discharged directly into the river.

Both of these paper mills have a mechanical filter plant, and filter from 1,000,000 to 2,000,000 gallons of water daily; but the dirt taken from the water by these filters is washed back into the river when the filters are cleaned. The water as discharged from the mill of Hollingsworth & Vose shows a considerable increase in total solids, loss on ignition, oxygen consumed and hardness, but ordinarily very little increase in the amount of nitrogen present over that in the water of the mill pond above. This is owing to the fact that about one-half of the water used at this mill is drawn through an eight-inch pipe from the mill pond above Bird's and the water taken from their own mill pond is filtered. Eventually, as I have said before, however, all the filth removed by these filters is turned into the river again. Measurements of the water used show that, at the present time at least, each mill uses between 2,000,000 and 3,000,000 gallons of water daily. A large number of samples of the waste liquors have been analyzed, and it can be said that they are rather worse in appearance than in analysis. A large percentage of the organic pollution present is carbonaceous matter, not easily decomposable, being the fibre that passes through the paper machines; and the liquors in themselves have not an offensive odor, but contain a very large amount of matter that deposits upon the bed of the river and, when mixed with the sewages entering the river, farther down in its course, aids largely in increasing the offensive character of the river.

An average analysis of the mixed waste liquors from Bird's mill is about as follows, although at times these liquors are much worse than these averages :—

[Parts per 100,000.]

| Residue on Evaporation. | Loss on Ignition. | AMMONIA. |             | Chlorine. | Oxygen Consumed. | Hardness. |
|-------------------------|-------------------|----------|-------------|-----------|------------------|-----------|
|                         |                   | Free.    | Albuminoid. |           |                  |           |
| 43.00                   | 20.00             | .0200    | .1500       | 1.00      | 3.00             | 11.50     |

*From the Mill of Hollingsworth & Vose.*

[Parts per 100,000.]

| Residue on Evaporation. | Loss on Ignition. | AMMONIA. |             | Chlorine. | Oxygen Consumed. | Hardness. |
|-------------------------|-------------------|----------|-------------|-----------|------------------|-----------|
|                         |                   | Free.    | Albuminoid. |           |                  |           |
| 51.00                   | 31.00             | .0150    | .1500       | 1.50      | 4.00             | 18.80     |

Experiments have been made in regard to the feasibility of filtering these liquors through sand, and also in regard to the amount of purification that could be obtained by sedimentation and chemical precipitation. A small filter has been operated, at the rate of 200,000 gallons per acre daily. The effluent of this filter is a clear, bright water, with very little organic matter contained in it; but, from the small amount of nitrification obtained, there is evidently considerable storage of nitrogen in the upper layers of the filter, and once during the five months of operation of this filter a film of carbonaceous matter, apparently fibre, has had to be removed from its surface. I have no doubt that this filter could be operated at twice its present rate with as good results, but, of course, with greater storage of nitrogen. Results upon sedimentation are that about 30 per cent. of the total organic pollutions are removed from these liquids when they are allowed to stand and settle for one hour, and that a period of sedimentation two or three times as long improves this result little, if any. This proportion of removal can be increased to about 45 per cent. if either ferrous sulphate or aluminum sulphate is added in the proportion of 500 pounds per 1,000,000 gallons of liquor treated. This method would involve large settling tanks and filter presses to care for the sludge.

To take care of Bird's liquors above the mill of Hollingsworth & Vose these settling basins could not be over 4 feet in depth, if



the liquors were to run into them by gravity; and to care for one hour's flow a basin would have to be 50 feet long and 30 feet wide, with this depth of 4 feet. At least three of these settling basins would be needed, and apparently the only location at all suitable for them is a narrow strip of land some six or seven hundred feet below the mill. All the waste liquors have at the present time a natural settling basin in the mill pond itself, and during the season of low water all the water flowing from this pond, with the exception of a small amount of leakage through the wheel and around the dam, is used by Hollingsworth & Vose.

Below this mill settling basins at least 15 feet deep could be arranged, and have the entire waste liquors flow into them by gravity; and if it were decided to partially purify the wastes from these mills by sedimentation, I think that during those months of the year when Hollingsworth & Vose can obtain a sufficient volume of water for their processes without using the waste water from Bird's this waste water might flow to these last settling basins, and that during the months when it is necessary for Hollingsworth & Vose to use Bird's waste water it could go into the mill pond without any further clarification by sedimentation than what would take place in this pond.

A large proportion of the organic pollution in these waste liquors is in suspension, and is readily screened out by means of wire screens. During the past year a contrivance known as a "save-all" has been put in operation in the mill of Hollingsworth & Vose, and the waste liquor from one of the paper machines passes through it, and a large amount of paper fibre is thus screened out and saved. This company is about to arrange its plant so that all its waste liquors, from the paper machines and beating the stock, will pass through these "save-alls," and in this way a very large amount of fibre now passing into the river to be deposited along its bed will be kept out.

These "save-alls" should also be put in operation in the mill of F. W. Bird & Son.

Experiments at the laboratory have shown that the waste liquors can be passed through a coke strainer at a very high rate and give an entirely satisfactory effluent. The liquors without any preliminary screening have been applied at a rate of 1,000,000 gallons per acre daily. With the preliminary screening through the "save-alls" the rate could be increased to two or three times this, and give a

satisfactory result. The coke has also the power of removing to a very considerable extent the dyestuffs which now color the river. The cost of a coke strainer would not be excessive, and the dirt and coke removed from its surface from time to time could be burned. In regard to the location of the strainer, the same can be said as in regard to settling basins. The waste liquors from both mills, after passing through the "save-alls," could flow to a place below the mill of Hollingsworth & Vose except during that season of the year when, owing to low water, all of Bird's waste liquor has to be used by Hollingsworth & Vose.

The river for two or three miles below these paper mills is generally colored to a considerable extent, but seldom has an offensive odor. After receiving the sewage from the tanneries of Winslow Brothers and Lyman Smith's Sons, however, the river becomes decidedly offensive, both in appearance and odor, and the pollutions of the water increase four or five fold. These two tanneries are engaged in preparing and tanning sheep skins, and turn out from 20,000 to 50,000 gallons each of sewage every twenty-four hours. The sewage from the two places is almost identical in composition, is always stronger than ordinary town or city sewage, and generally five or six times as strong. An average of many analyses of this sewage is as follows:—

[Parts per 100,000.]

| AMMONIA. |             | Organic Nitrogen<br>(Kjeldahl). | Chlorine. | Oxygen Consumed. |
|----------|-------------|---------------------------------|-----------|------------------|
| Free.    | Albuminoid. |                                 |           |                  |
| 5.06     | 3.54        | 6.00                            | 436.40    | 64.50            |

In applying this sewage directly to a shallow sand filter we have removed 85 per cent. of its organic matter; but nitrification, upon which the life of a sewage filter depends, has been very feeble, owing, I believe, to the small depth of sand in the filter and rate of application of the sewage. A filter to which the sewage has been applied, after allowing it to stand and some of the sludge to settle out, has been in operation since the beginning of the year, and for the past seven months has been in a state of exceedingly active nitrification, and has given a good-appearing and almost odorless effluent, containing but a small percentage of the original organic matter of

the applied sewage. The filter has been operated at an average rate of 40,000 gallons per acre daily, and there has been no removal of sand or sludge from its surface.

Another filter in operation at the station for the past six months has received a mixture of Lawrence sewage and tannery sewage in the proportion of two parts of the former to one of the latter, and has been operated at a rate of 50,000 gallons per acre daily. Nitri-fication has been active in the filter, and its effluent clear and odorless. In fact our experiments have shown that this sewage can be disposed of and purified upon land either mixed with ordinary town sewage or by itself after the removal, by sedimentation, of a certain percentage of the sludge contained in it. This sludge could be separated from the main body of the sewage in a moderately sized settling basin, and, as it contains several times as much nitrogen as the same volume of sludge from town sewage, would be worth carting away by the farmers of the neighborhood.

In regard to land of a suitable character for filtration, there is a considerable area along and near the Neponset River, to which the sewage of these tanneries and the village would flow.

The river as it enters the meadows is, during the summer months, a stream of moderately strong sewage, containing generally no dissolved oxygen; but, as the water flows slowly through the meadows, it is improved in character by sedimentation and also by dilution, owing to the entrance into it of a number of brooks of much purer water.

In conclusion, it can be said that, by caring for the waste liquors of the manufacturing industries in the manner here outlined and preventing in the future the entrance of town or industrial sewage into the river, the character of its water can be permanently improved.

The Massachusetts Drainage Commission in 1886 indicated land suitable for sewage disposal; and a further study of the character of the land of the several towns upon the Neponset water-shed has shown that there would probably be no difficulty in locating suitable areas for this purpose.

Yours respectfully,

H. W. CLARK,

*Chemist in charge of Lawrence Experiment Station.*













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1959



